GATES LEARJET CORPORATION

# maintenance manual

# CHAPTER

# 71

# POWER PLANT

RECORD OF TEMPORARY REVISIONS

| Rev. No. | Date Inserted | Date Removed | Page Number | Rev. No. | Date Inserted | Date Removed | Page Number |
|---|---|---|---|---|---|---|---|
| 71-1 | Nov 16/79 | Apr 30/82 Rev #14 | 71-20-00 Pg 201 | | | | |
| 71-2 | Jun 12/81 | Apr 30/82 Rev #14 | 71-20-00 Pg 203 | | | | |
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| Chapter Section Subject | Page | Date |
|---|---|---|
| 71-Title | | |
| *71-Record of Temp. Revisions | | Apr 30/82 |
| *71-List of Effective Pages | 1 | Apr 30/82 |
| 71-Contents | 1 | Dec 2/77 |
| 71-00-00 | 1 | Dec 2/77 |
| 71-00-00 | 201 | Dec 2/77 |
| 71-00-00 | 202 | Dec 2/77 |
| 71-00-00 | 203 | Dec 2/77 |
| 71-00-00 | 204 | Dec 2/77 |
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| 71-00-00 | 209 | Aug 27/79 |
| 71-00-00 | 210 | Aug 27/79 |
| 71-00-00 | 211 | Aug 27/79 |
| 71-10-00 | 201 | Dec 2/77 |
| 71-10-00 | 202 | Dec 2/77 |
| 71-10-00 | 203 | Dec 2/77 |
| *71-20-00 | 201 | Apr 30/82 |
| *71-20-00 | 202 | Apr 30/82 |
| *71-20-00 | 203 | Apr 30/82 |
| *71-20-00 | 204 | Apr 30/82 |
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*Asterisk indicates pages revised, added, or deleted by current revision.
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## GENERAL - DESCRIPTION AND OPERATION

1. General

A. The aircraft is powered by two General Electric CJ610 single-rotor axial-flow turbojet engines. The engines are installed in pylon-mounted nacelles, one located on each side of the aft fuselage. The engine assembly consists of an eight-stage axial flow compressor, driven by a two stage turbine, an annular combustion section, a fixed-area concentric exhaust cone, and an integrated control system. Each engine is attached to two engine beams at three attachment points. Individual thrust levers, located on the cockpit center pedestal, govern engine power by regulating each engine fuel control unit. Each engine exhaust system incorporates a stainless steel shroud to provide increased cooling throughout the nacelle in all flight conditions and ground operation. Eight chromel-alumel thermocouples, at two different immersion depths in the exhaust stream, generate an average value of exhaust gas temperature which is indicated on the EGT indicators in the cockpit. An engine-driven starter-generator is installed on each engine to provide engine starting and furnish 30-volt 400-amp DC power to the aircraft electrical system. Compressor discharge air (bleed air), released through two main frame ports on each engine, is used for cabin air conditioning, cabin pressurization, windshield defogging, engine inlet anti-icing, and wing anti-icing.

B. Basic engine maintenance and instructions relative to trouble shooting, removal, installation, and adjustment of basic engine components are not included in this service manual. For detail engine component maintenance instructions, refer to the following applicable General Electric Publications:

| Title | Publication No. |
|---|---|
| CJ610 Turbojet Engine Maintenance Manual | SEI-186 |
| CJ610 Turbojet Engine Overhaul Manual | SEI-136 |
| CJ610 Turbojet Engine Illustrated Parts Catalog | SEI-137 |

## GENERAL - MAINTENANCE PRACTICES

1. General
   A. Maintenance practices consist of servicing, removal and installation for engine overhaul and engine replacement procedures.

2. Maintenance Precautions
   A. The following maintenance precautions should be followed to prolong the life of the engine. Maintenance personnel should read and thoroughly understand these precautions.
      (1) Use extreme care to prevent dirt, hardware, tools or other foreign material from entering the engine.
      (2) Handle fuel and oil lines carefully to avoid denting or kinking. Be especially careful not to damage threads of fittings and line coupling nuts.
      (3) All lines, ducts and electrical connectors that terminate with open ends should be capped or covered in a suitable manner to exclude the entrance of dirt and foreign matter.
      (4) Caps or covers should not be removed until immediately before installation.
      (5) Prior to installing any part, assure that it is thoroughly clean.
      (6) Do not remove O-rings and gaskets from their packages until needed for assembly.
      (7) Clean O-ring and gaskets, if necessary, prior to installation with dry air under pressure or with clean, lint-free rags. Do not use solvents.
      (8) Visually inspect all O-rings and gaskets for cuts, nicks and other flaws prior to installation.
      (9) Lubricate O-rings, backup rings and gaskets with appropriate system fluid prior to installation.
      (10) Do not twist hose assemblies when installing. The stripe on the side of the hose will show if any twist exists. A twisted hose under pressure may fail or loosen itself.
      (11) It is important to use correct size and type of clamps when securing various hoses, tubing and wire bundles directly to the engine or engine brackets. If clamps of insufficient size are used and tightened excessively, the line may be damaged by not being able to slip through the clamp when the engine thermally expands.
      (12) Route and clamp all lines and electrical wiring as shown. This will keep chafing to a minimum.
      (13) All electrical bonding, grounding and mating surfaces shall be clean, metal surfaces free of grease, paint or other high resistance film. Whenever paint has been removed to make connections, the connection should be refinished to prevent corrosion.
      (14) Use safety wire to secure bolts and fittings as required.

3. Tools and Equipment

| NAME | PART NUMBER | MANUFACTURER | USE |
|---|---|---|---|
| Engine Stand | Tool No. 32443 | Gates Learjet | General |
| Engine Hoist | 2-136 | WARDAERO, Three Rivers, Michigan Subsidiary of Medalist Ind. | General |
| Engine Sling | 2C5327 | General Electric | General |

4. Removal/Installation

NOTE: The removal and installation procedures for the left and right engines are identical unless otherwise noted.

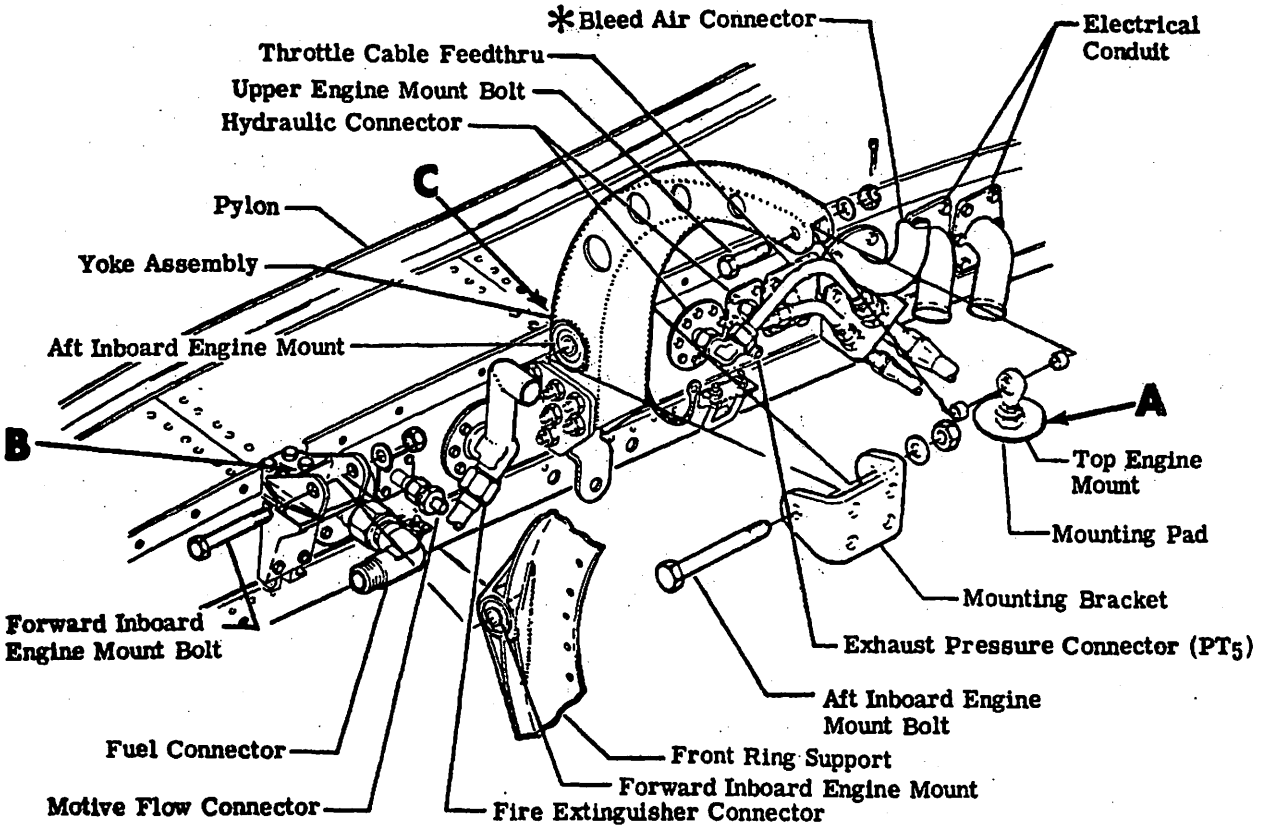
A. Remove Engine (See figure 201)
(1) Set Battery Switches to BAT 1 and BAT 2 and depress the LH and RH FIRE Switches on the glareshield to close the fuel and hydraulic firewall shutoff valves. Check that armed lights are lighted.
(2) Set Battery Switches to OFF and pull and tag LH and RH fire extinguisher circuit breakers.
(3) Disconnect aircraft batteries.
(4) Remove lower engine nacelle.
(5) Release clamps securing fire sensing element to rear nacelle.

NOTE: The fire detection elements are removed with the upper nacelle.

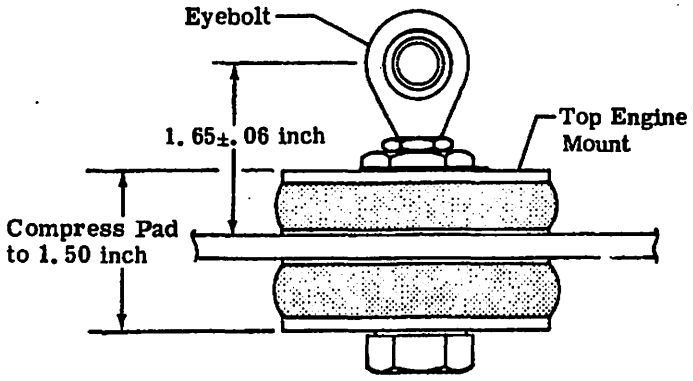
(6) Remove upper nacelle.
(7) Disconnect throttle cable from fuel control unit bellcrank.
(8) Remove bolts attaching throttle cable bracket to fuel-oil cooler.
(9) Remove clamps attaching throttle cable to engine.
(10) Loosen hydraulic supply and return hoses at hydraulic pump sufficiently to bleed off hydraulic pressure. When all pressure is released, disconnect hoses from pump.
(11) Disconnect and cap the following at the pylon firewall:
(a) Exhaust pressure line
(b) Main fuel hose.

CAUTION: ENGINE BLEED AIR DUCTING DAMAGE COULD RESULT FROM EXCESSIVE BENDING. DISCONNECT ENGINE BLEED AIR DUCTING AT BOTH ENDS AND REMOVE FROM AIRCRAFT.

* Do not bend engine bleed air ducting. Disconnect ducting at the bleed air connector and at the engine.

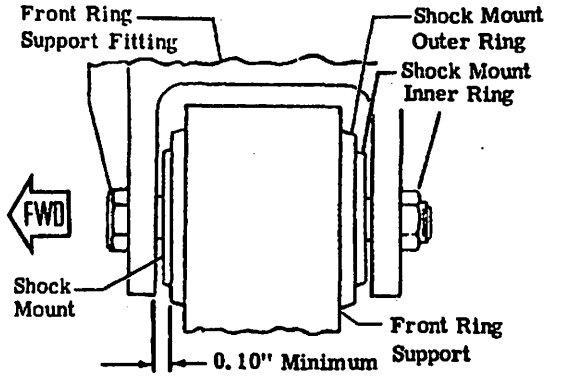



Engine Installation
Figure 201 (Sheet 1 of 4)



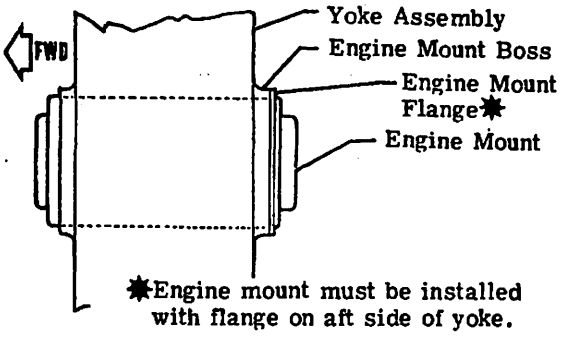

TOP ENGINE MOUNT INSTALLATION

**Detail A**



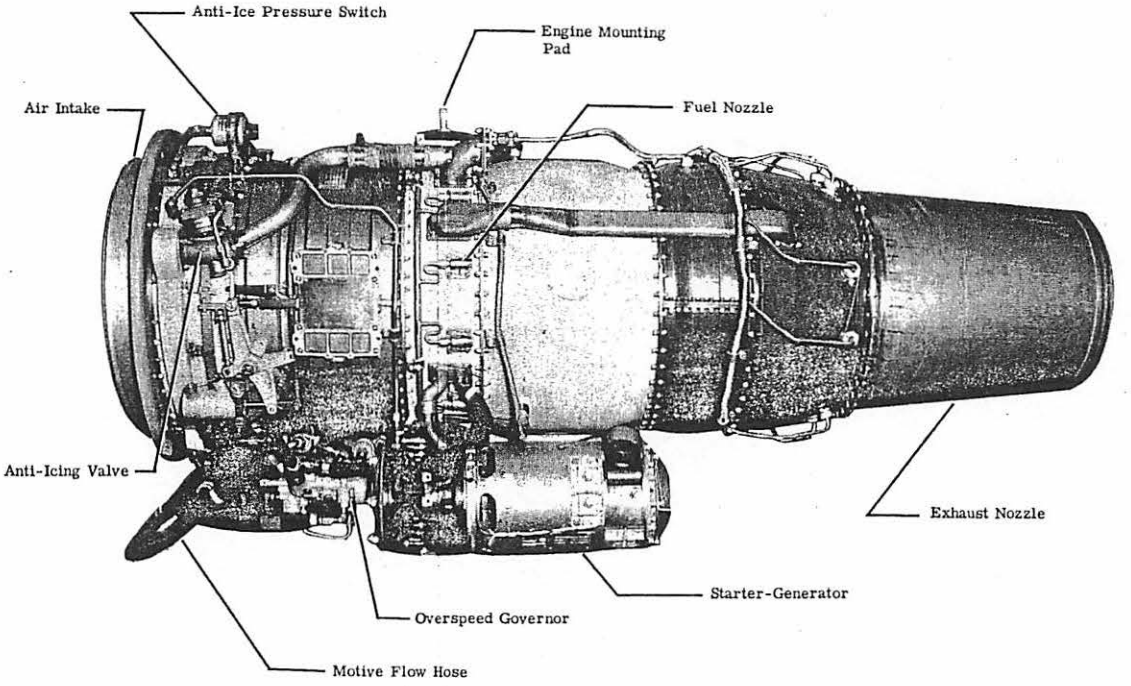

FORWARD INBOARD ENGINE MOUNT INSTALLATION

**Detail B**

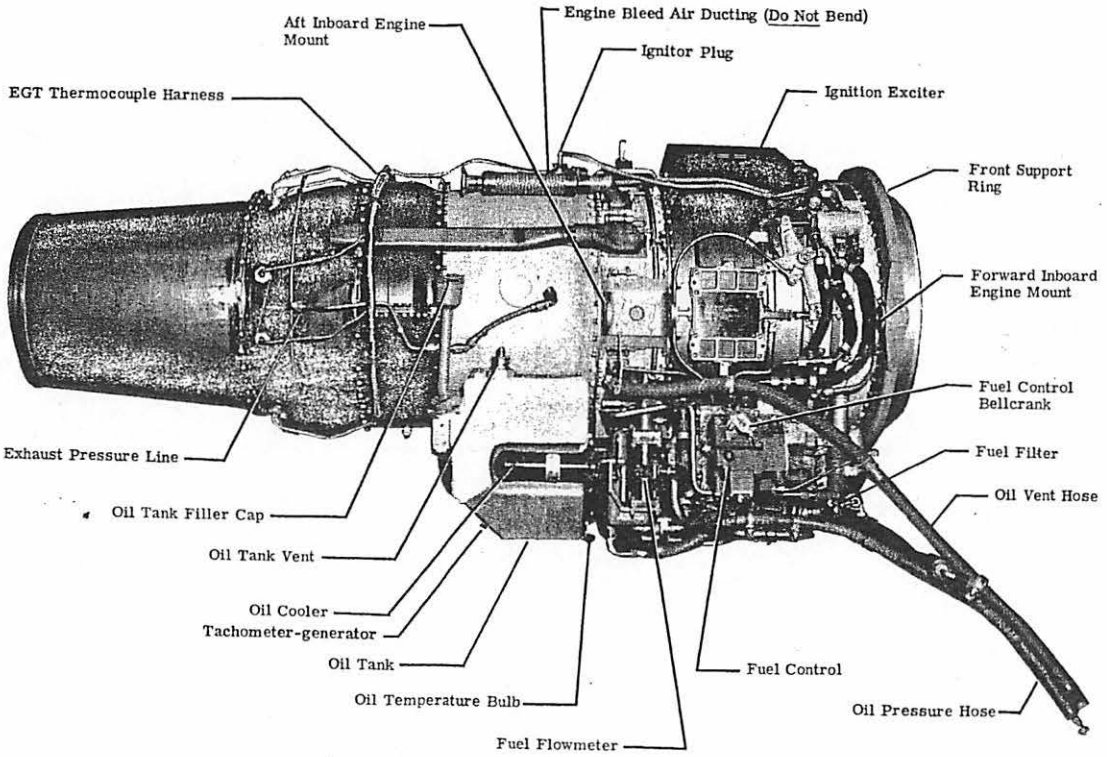



**Detail C**

Engine Installation
Figure 201 (Sheet 2 of 4)




Engine Installation
Figure 201 (Sheet 3 of 4)




Engine Installation
Figure 201 (Sheet 4 of 4)

(c) Bleed air ducting.
(d) Motive flow line.
(e) Fire extinguisher line.

(12) Disconnect bonding cables from aft engine mount bracket.
(13) Disconnect cooling duct from starter-generator.
(14) Disconnect hoses from oil pressure transmitter.
(15) Disconnect fuel control sensing hose.
(16) Disconnect and free electrical wiring connected to the following units:
(a) Fuel flowmeter
(b) Oil pressure transmitter
(c) Starter-generator
(d) Ignition exciter
(e) Anti-ice relay
(f) Anti-ice pressure switch
(g) Oil temperature bulb
(h) Tachometer-generator
(i) Anti-ice valve
(j) EGT thermocouple harness
(17) Support nose cap air intake and remove engine intake seal clamp.
(18) Attach engine sling (General Electric P/N 2C5327, or equivalent and hoist to engine.)
(19) Remove engine mounting bolts and lower engine to an engine stand.

B. Install Engine (See figure 201)

NOTE: This procedure is applicable to either engine.

(1) Attach engine sling and hoist to engine and raise engine to align with engine mounts.
(2) If replacing top engine mount, adjust eyebolt as shown in detail A.
(3) Install and torque engine mounting bolts.

NOTE: Torque upper engine mount bolt to 95 to 110 inch-pounds. Torque forward inboard engine mount bolt to 20 to 25 inch-pounds. Torque aft inboard engine mount bolt to 290 to 410 inch-pounds.

(4) Check clearance between forward face of engine shock mount outer ring and front ring support fitting as shown.

NOTE: The shock mount outer ring may be shifted aft until its forward face is flush with the forward face of the front support ring. This is acceptable provided the minimum clearance between the forward face of the front support ring and the front ring support fitting is 0.10 inch. The

shock mount outer ring forward face shall not be less than flush with the front ring support.

CAUTION: REPLACE ALL SAFETY WIRES REMOVED DURING ENGINE REMOVAL.

PRIOR TO INSTALLING NOSE CAP AIR INTAKE CLAMP, CHECK GAP AND ALIGNMENT DIMENSIONS BETWEEN NOSE CAP AIR INTAKE AND ENGINE INTAKE; REFER TO FIGURE 201. EXCESSIVE GAP OR MISALIGNMENT MAY RESULT IN THE INGESTION OF THE INTAKE SEAL BY THE ENGINE.

(5) Install nose cap air intake clamp and torque T-bolt 12 to 15 inch-pounds. Do not install clamp with T-bolt over horizontal weld seam of inlet duct.
(6) Connect and clamp electrical wiring to the following units and safety all electrical connectors.
  (a) EGT thermocouple harness
  (b) Anti-ice valve
  (c) Tachometer-generator
  (d) Oil temperature bulb
  (e) Anti-ice pressure switch
  (f) Anti-ice relay
  (g) Ignition exciter
  (h) Starter-generator
  (i) Oil pressure transmitter
  (j) Fuel flowmeter
(7) Connect hoses to oil pressure transmitter.
(8) Connect fuel control sensing hose.
(9) Connect cooling duct to starter-generator.
(10) Connect bonding cables to aft engine mount bracket.
(11) Connect the following at the pylon firewall:
  (a) Bleed air ducting (also connect to engine)
  (b) Main fuel hose
  (c) Exhaust pressure line
  (d) Motive flow line
  (e) Fire extinguisher line
(12) Connect throttle cable to fuel control bellcrank.
(13) Install bolts attaching throttle cable bracket to fuel-oil cooler.
(14) Install clamps securing throttle cable to engine.
(15) Install upper and rear engine nacelle.
(16) Secure rear fire detect element to rear nacelle.
(17) Check throttle cable rigging.
(18) Connect aircraft batteries and open engine main shutoff valves. Install lower engine nacelle.

(19) Bleed the hydraulic system. (Refer to 29-00-00).

(20) Perform engine motoring check. (Refer to Engine Maintenance Manual SEI-186).

(21) Perform engine operational check.

C. Engine Ground Operation

(1) Refer to Engine Operating Instructions Manual SEI-188.

D. Activating Engine After Storage

(1) Prime the lube and scavenge pump as outlined in General Electric CJ610 Maintenance Manual SEI-186 if any of the following conditions exist: (1) Engine has not been operated within 14 days or longer, (2) engine is being tested for first time since installation, (3) engine is being tested for first time since preservation, or (4) engine is being tested since replacement of lube and scavenge pump.

5. Adjustment/Test (Aircraft Certified at 51,000 feet Operation)

A. Maximum Altitude (51,000 feet) Engine Flight Test

NOTE: Flight testing is required following: (1) an engine change (2) a periodic inspection, if the engine has been subjected to maintenance that affects performance (3) a hot section inspection (4) a fuel control change (5) variable geometry system adjustment. This check is also recommended if the pilot's post flight report indicates there may be an engine operational problem.

WARNING: OBSERVE ALL FLIGHT LIMITATIONS (REFER TO THE APPROVED AIRPLANE FLIGHT MANUAL).

(1) Perform the Maximum Altitude, Maximum Power Check as follows:

(a) Ensure that fuel control density set to nominal for the fuel in use. (Refer to the Approved Airplane Flight Manual.)

(b) Establish stabilized flight parameters within the aircraft flight envelope (refer to Approved Airplane Flight Manual). Any aircraft flight problems encountered shall be corrected before continuing the check.

(c) Turn "off" anti-ice systems.

(d) Establish airspeed at .76 Mach.

(e) Advance test engine power lever to maximum stop on throttle quadrant, retard opposite engine as required to maintain airspeed at .76 Mach. Stabilize engine power and ram air temperature (RAT).

(f) Record test engine parameters: % RPM, EGT, RAT, fuel flow, airspeed (Mach No.) and EPR.

(g) Determine the minimum power requirements at 51,000 feet. (Refer "Engine Power Requirements vs Compressor Inlet Temperature, Anti-ice Off, Maximum Continuous Power Chart" in the Approved Airplane Flight Manual.)

(h) If engine fails power requirements at altitude, trouble shoot and repair engine. (Refer to the General Electric Maintenance Manual, SEI-186.)

(2) Perform the Maximum Altitude Acceleration Check as follows:

NOTE: Engine fuel control density should be set one adjustment lower in density than the fuel in use. (Refer to Approved Airplane Flight Manual.)

(a) Establish stabilized flight parameters within the flight envelope (refer to Approved Airplane Flight Manual). Any aircraft flight problem encountered shall be corrected before continuing this check.

(b) Turn "off" anti-icing systems.

WARNING: AT ALTITUDE, AIRSPEED SHALL NOT FALL BELOW .65 MACH (REFER TO APPROVED AIRPLANE FLIGHT MANUAL FOR FLIGHT LIMITATIONS).

(c) Establish airspeed at .65 Mach. Stabilize engine power and ram air temperature (RAT).

(d) Record test engine parameters: % RPM, EGT, RAT, fuel flow, airspeed (Mach No.), and EPR.

NOTE: Make throttle movements in a smooth and normal manner. Quick throttle retard followed by immediate advance will make the check invalid.

While performing this check, it is permissible to exceed maximum continuous EGT up to the levels and times specified in the EGT curves in the Approved Airplane Flight Manual. Reset throttle at or below maximum continuous power as soon as practical.

WARNING: FLIGHT CHARACTERISTICS OF THE AIRCRAFT MAY CHANGE IF THE TEST ENGINE FAILS (ENGINE STALL) THE ACCELERATION CHECK. IF ENGINE FAILS (ENGINE STALL) THE THROTTLE ON THE OPERATING ENGINE SHOULD NOT BE MOVED UNTIL A LOWER ALTITUDE IS ATTAINED (REFER TO THE APPROVED AIRPLANE FLIGHT MANUAL FOR ENGINE AIRSTART PROCEDURES).

(e) Retard test engine throttle to 2% below maximum turbine speed (% RPM), while maintaining aircraft altitude and airspeed with the other engine.

(f) Stabilize turbine speed (% RPM) at 2% below maximum for 25 to 35 seconds.

(g) Advance the test engine throttle (in a smooth and normal manner) in one second or less to the maximum throttle stop on the quadrant. Record maximum % RPM obtained and RAT.

(h) Repeat steps (e) thru (g) for 5% below maximum turbine speed (% RPM).

(i) Repeat steps (e) thru (g) for 85% RPM turbine speed.

(j) If engine fails altitude acceleration test at 51,000 feet, trouble shoot and repair. (Refer to General Electric Maintenance Manual, SEI-186.)

## COWLING - MAINTENANCE PRACTICES

1. General
   A. Each engine nacelle assembly consists of four sections; a nose cap air intake, a lower section, an upper section, and a rear nacelle. Each section, interlocked and secured with fasteners, is easily removed for engine maintenance and inspection. Airscoops are installed in the nacelles for starter-generator and engine cooling. An access door, secured by fasteners, is installed in the upper nacelle section for access to the engine oil filler and dipstick.

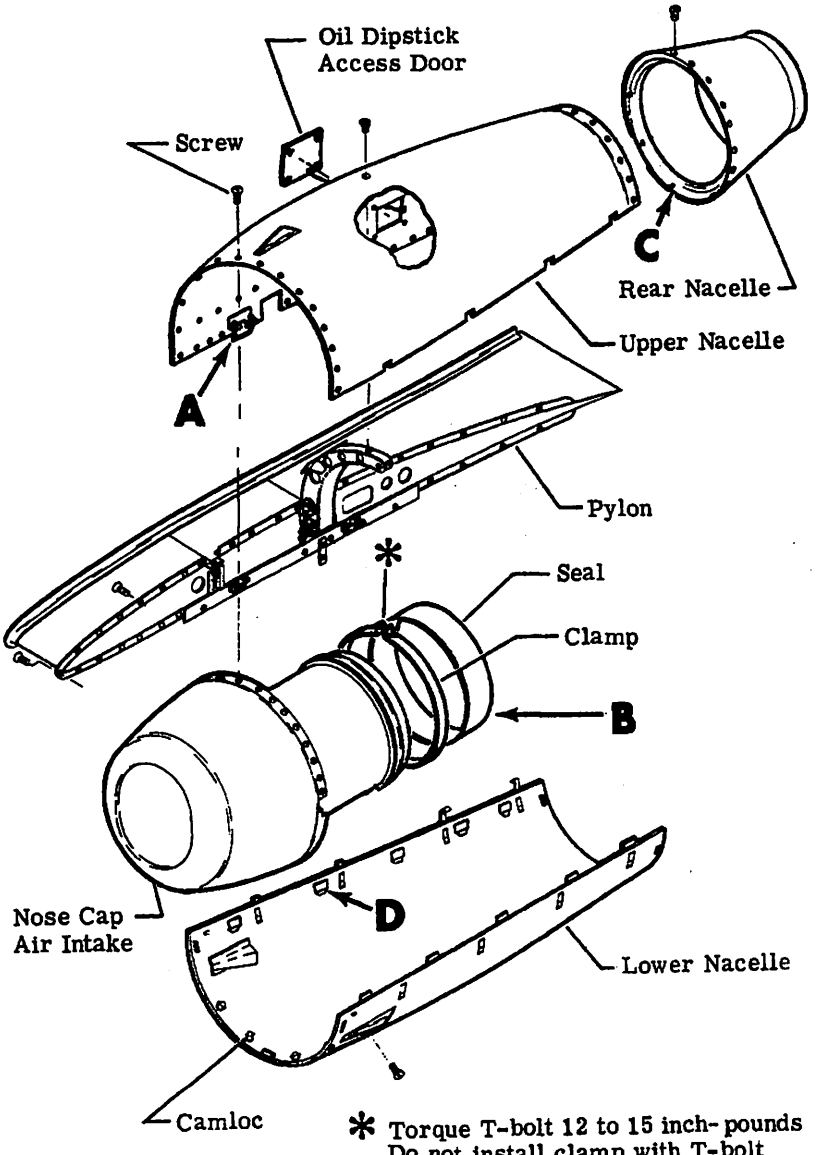
2. Removal/Installation
   A. Remove Nacelle Covers (See figure 201)
      (1) Support lower nacelle cover and release quick-release fasteners.
      (2) Lower nacelle cover clear of drain lines and remove from engine.
      (3) Remove screws securing upper nacelle cover and remove cover from engine.
      (4) Loosen clamp securing seal to nose cap and air intake.
      (5) Remove attaching parts and nose cap and air intake from engine.
      (6) Remove attaching parts and rear nacelle from engine.
   B. Install Nacelle Covers (See figure 201)
      (1) Install rear nacelle and secure with attaching parts.
      (2) Install nose cap and air intake with attaching parts. Place block between bottom of intake and wing for support.
      (3) Install upper nacelle and secure with attaching parts.
      (4) Install lower nacelle and secure with quick-release fasteners.
      (5) Remove block from beneath intake.
      (6) Check nacelle installation.

3. Adjustment/Test
   A. Nacelle Installation Check
      (1) Upper nacelle screws are properly secured.

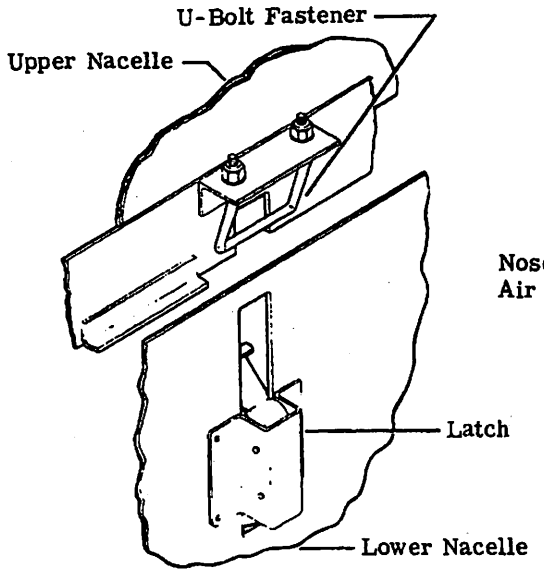
      CAUTION: AVOID APPLYING EXCESSIVE FORCE IN CLOSING THE LATCHES AS DISTORTION OR DAMAGE TO THE U-BOLT FASTENERS AND LATCHES COULD RESULT POSSIBLY CAUSING THE LOSS OF THE LOWER NACELLE IN FLIGHT.

      (2) Sufficient tension for positive engagement of the latches by using thumb pressure.
      (3) A gap of 0.03 to 0.09 inch between upper nacelle and lower nacelle skin. Adjustment for this dimension can be achieved by adjusting the nacelle alignment clip spacers, one serration at a time (0.06 inch), and adjusting the U-bolt fastener jamnuts.

(4) A dimension between the upper nacelle rolled flange and nacelle alignment clip spacer should be 0.06 inch maximum. Check this dimension by inserting a short piece of wire with a 0.06 inch diameter into the inspection holes located at each nacalle alignment clip.
(5) Assure that lower nacelle camloc and screw fasteners are properly secured.

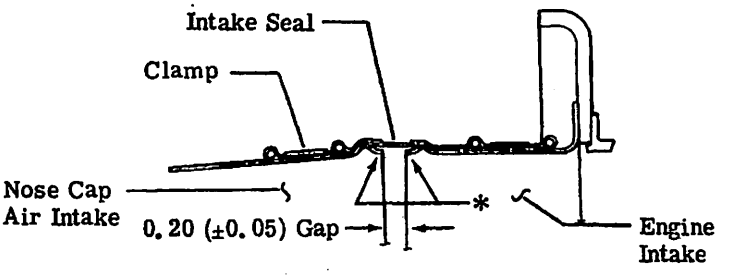



Engine Nacelle Installation
Figure 201 (Sheet 1 of 2)



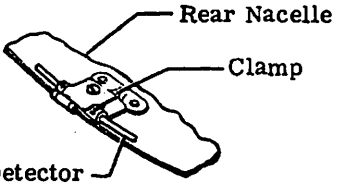

LATCH INSTALLATION

A



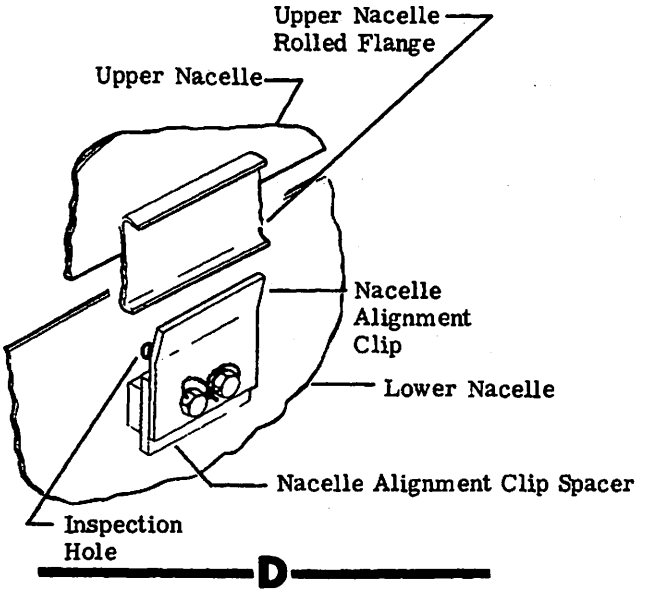

ENGINE INLET SEAL INSTALLATION

B




TYPICAL FIRE DETECTOR CLAMP

C




D

Engine Nacelle Installation
Figure 201 (Sheet 2 of 2)

## ENGINE MOUNT - MAINTENANCE PRACTICES

1. General
   A. Engine mounts are installed to minimize transfer of engine vibration to the fuselage.
   B. In accordance with the current inspection intervals specified in Chapter 5, the engine mounts must be inspected. This inspection will coincide with the engine hot section inspection.

2. Removal/Installation
   A. Remove Top Engine Mount
      (1) With the engine removed from the aircraft, remove the bolts which secure the mounting pad to the engine. Remove mounting pad from engine.
      (2) Cut and remove safety wire from jamnut and bolt.
      (3) Loosen the smaller jamnut and unscrew eyebolt from the assembly.
      (4) Loosen the larger jamnut and remove nut, bolt, upper bonded sandwich, lower bonded sandwich and center spacer.

      NOTE: Inspect or discard the upper bonded sandwich, lower bonded sandwich and center spacer as dictated in Chapter 5.

   B. Install Top Engine Mount

      NOTE: The top sandwich is ink stamped "TOP" and the lower sandwich is ink stamped "BOTTOM".

      (1) Position bottom sandwich on engine mounting pad, insert center spacer and position top sandwich over center spacer.

      NOTE: The sandwich assembly must be compressed in order to start nut on bolt. C-clamps may be used to compress sandwich assembly.

      (2) With the sandwich assembly compressed, insert bolt into bottom sandwich and thread nut onto bolt.
      (3) Remove clamps and tighten nut until the sandwich assembly is compressed to the dimension shown.
      (4) Thread small jamnut fully onto eyebolt.
      (5) Screw eyebolt into bolt and adjust to the dimension shown. Position hole in eyebolt so that its centerline is parallel with the engine centerline and tighten jamnut.
      (6) Safety wire large jamnut and bolt head.
      (7) Position mounting pad on engine, install bolts and nuts and tighten.

C. Remove Forward Inboard Engine Mount
   (1) With the engine removed from the aircraft, remove attaching parts and front ring support from engine.
   (2) Press the engine mount from the front ring support. Discard mount.
   (3) Clean engine mount cavity of front ring support.

D. Install Forward Inboard Engine Mount
   (1) Apply zinc chromate primer to and press fit engine mount into front ring support while primer is still wet. Engine mount should protrude 0.220 (±.010) inch (5.588 ±.254 mm) beyond the front face of the ring support.
   (2) Install front ring support on engine and secure with attaching parts.

E. Remove Aft Inboard Engine Mount
   (1) With the engine removed from the aircraft, remove attaching parts and yoke assembly from pylon.
   (2) Press aft inboard engine mount out of yoke assembly from the forward side of the yoke assembly.

   NOTE: The aft inboard engine mount has a flange on the aft end and can only be pressed out of the yoke assembly from the forward side.

   (3) Clean inside of engine mount cavity in the yoke assembly.

F. Install Aft Inboard Engine Mount
   (1) Apply zinc chromate primer to and press fit engine mount into yoke assembly from aft side while primer is still wet.

   NOTE: The inboard engine mount has a flange on one end. This flange must be on the aft side of the yoke assembly after installation.

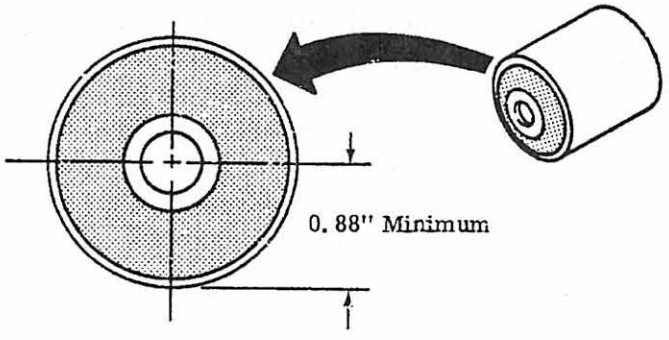
   (2) Install yoke assembly on pylon and secure with attaching parts.

3. Inspection/Check

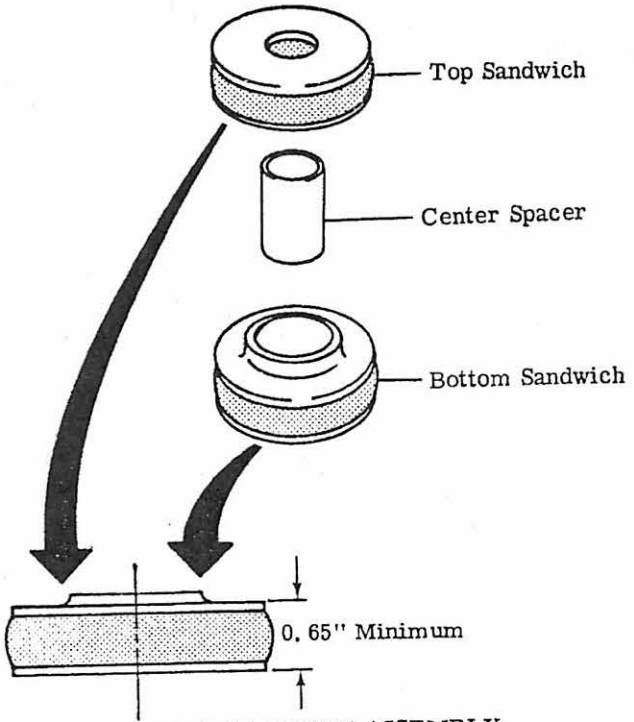
A. Inspect Engine Mounts as follows:
   (1) Remove top engine mount from engine and disassemble the two bonded sandwiches from the center spacer.
   (2) Wipe all oil and dirt from the bonded parts with a clean, dry cloth.
   (3) Wash unbonded metal parts in dry cleaning solvent. Do not clean rubber parts in solvent.
   (4) Inspect the unbonded center spacer of the top main mount for nicks, scratches, gouges or cracks and replace if any are evident.

(5) Inspect both top main mount bonded rubber sandwiches as follows:
- (a) Inspect for metal to rubber bond separation and replace if separation has progressed 180° around circumference or has reached a depth of 0.10 inch (2.54 mm) or more.
- (b) Inspect for surface cracks on rubber caused by flexing and replace if they have reached a depth of 0.12 inch (3.04 mm) or more.
- (c) Inspect to see that rubber has returned to its original shape after load was removed. Replace sandwich if thickness is less than 0.65 inch (16.51 mm).
- (d) Visually inspect the end plates for nicks, scratches, gouges or cracks. Replace if any are evident.

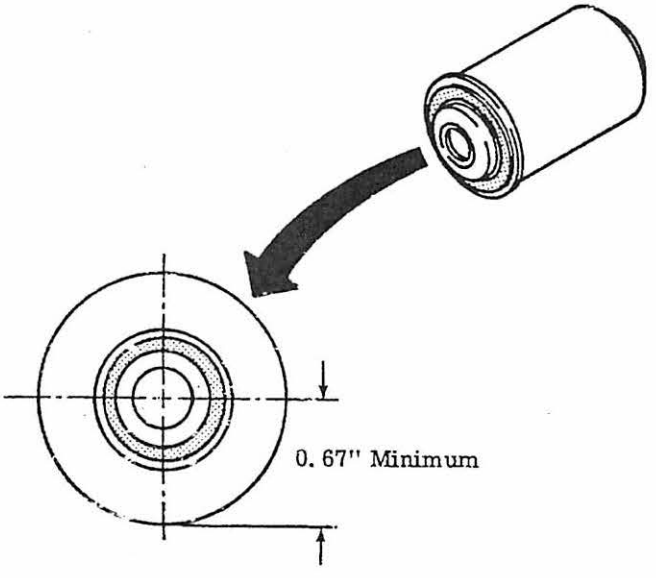
(6) Inspect the forward inboard and aft inboard mounts as follows:
- (a) Inspect for metal to rubber bond separation and replace if separation has progressed 90° around circumference or has reached a depth of .06 inch (1.52 mm) or more.
- (b) Inspect for surface cracks on the rubber caused from flexing and replace if they have reached a depth of .06 inch (1.52 mm) or more.
- (c) Inspect to see that rubber has returned to its original shape after load was removed. Replace aft inboard mount if radius is less than 0.88 inch (22.35 mm) at any given point. Replace forward inboard mount if the radius is less than 0.67 inch (17.01 mm) at any given point.




FORWARD INBOARD ENGINE MOUNT




TOP ENGINE MOUNT ASSEMBLY




AFT INBOARD ENGINE MOUNT

Engine Mount Inspection Requirements
Figure 201

4. Approved Repairs (See figure 202)

A. Engine yoke assembly fastener hole approved repairs are as follows:

NOTE: The following approved repairs are to be used in conjunction with the 6000-hour inspection and Special Inspection - Engine Change (Chapter 5).

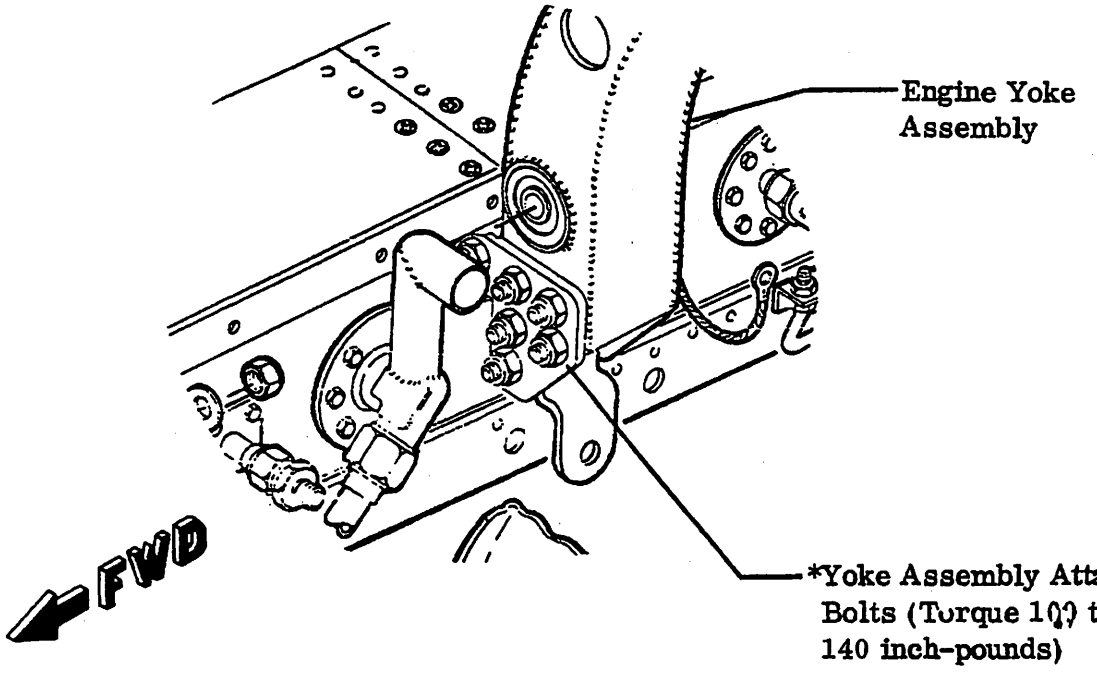
(1) Remove existing bolts, washers and nuts one at a time and measure the hole diameter. Holes should measure 0.3117 to 0.3127 inch.

(2) If an existing bolt hole measures greater than 0.3127, enlarge hole to 0.3276 to 0.3286 inch diameter. Replace existing attaching parts with an NAS2905-5 bolt, AN960-C516 washer and MS20364-524C nut. Torque nut 100 to 140 inch-pounds. Bolt head direction is optional.

(3) If an existing bolt hole measures greater than 0.3286, enlarge hole to 0.3432 to 0.3442 inch diameter. Replace existing attaching parts with NAS3005-5 bolt, AN960-C616 washer and MS20364-524C nut. Torque nut 100 to 140 inch-pounds. Bolt head direction is optional.

(4) If an existing bolt hole measures greater than 0.3442 inch diameter, contact Gates Learjet Field Service Department for disposition.

*Remove Bolts, Washers and Nuts one at a time.




Engine Yoke Assembly Fastener Hole Approved Repairs
Figure 202